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Analysis of Software Testing System in Civil Aviation Field

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Abstract

High reliability, safety and professional software quality are compelling requirement to software applied in civil aviation field. In this article, the status and characteristic of software testing in civil aviation field are summarized and analyzed. On the basis of analysis to the personal system of tester, testing environment and guaranty system of software testing, some constructive suggestions are presented for building up the integrated and efficient software testing system.

*Keywords:*Software Testing System; Civil Aviation; Software Quality

1. Introduction

Software testing is an important part in software development. It is aimed at verification of software product and for finding the bugs existed in software as soon as possible. Therefore, as an important way of guarantying software quality, software testing was integrated into and carried out in the whole systems development life cycle(SDLC) from program testing to the requirement analysis and design valuations。

For example, in the developed country, such as United States, software testing work in the whole software development process had been up to 15% now contrasting with the other parts of the development work. That was to say, software requirement analysis and software test plan was only about 3%, and design work, programming work was about 5% and 7%, the others about 67% was production and maintenance. Correspondingly, software testing's proportion in development process was still very low in China contrast with the developed countries although there was a obviously advancement in recent

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years.

Additionally, the insufficiency of software tester was also a big problem in China. For general testers, the proportion of to developers was less than 20% and far from the 50% in the developed countries. Moreover, the quantity of senior testers who at least had been undertaken the testing career for five years were only approximately 20,000. Some research statistics showed that the gross demand on the software tester had been up to 300,000. [1, 2]

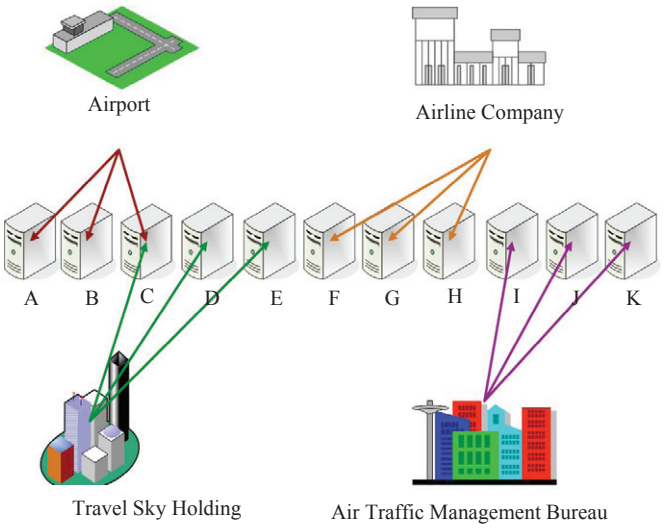
Therefore, under the background of software testing in China, it was very necessary to study the development of software testing in civil aviation to assure the applied software's safety and reliability. In this article, an investigation on the software testing in civil aviation was summarized and some advices also were put forward based on the analysis.

2 Characteristics of software applied in civil aviation and its development in software testing

2.1 Types of application software in civil aviation

In civil aviation field, the main organizations or companies engaging in application software development included airline company，Air Traffic Management Bureau (ATMB) and China Travel Sky Holding Company(Travel Sky Holding, CTH),etc.

During passed years of civil aviation informatization, all of above mentioned units had built up their core systems. In airports, the core system mainly included airport operation data base(AODB)，airport passenger processing system (APP) and security check system etc. In airline companies, there were core system on operation, such as flight control system, aircraft maintenance system and ticket sell system etc. To Air Traffic Management Bureaus, the core systems were automated system, air traffic management system, flight information system, flight telegraph processing system etc. As a professional software development company in civil field, CTH had developed many core systems used in civil aviation, such as departure control system (DCS), distribution system and transport tariff system etc. The Fig.1 showed out the different unit had different core system and there were many core core systems even in one unit.



A. flight information display system

B. Security check system
C. departure control system
D. distribution system
E. transport tariff system
F. ticket sell system
G. aircraft maintenance system
H. flight control system
I. flight telegraph processing system
J. air traffic management system
K. information system

Figure 1. A schematic of Core systems in civil aviation field

In one word, the first characteristic of applied software in civil aviation was that there were many types of software because of the diversity of business in civil aviation. This characteristic required the professional understanding on civil aviation business and therefore made testing work more difficult. The second characteristic of applied software in civil aviation was that there was more attention focused on the software quality. For example, the problem in Airborne software maybe cause serious disaster. Therefore, the great attention must be paid on the software testing for high quality.

2.2 Characteristics of software testing applied in civil aviation

Because of the differences in construction of core software system in civil aviation, the testing methods were also different and could be come down to several types according to their characteristics.

Firstly, the big organizations or companies which core systems mainly were configured by purchasing could be characterized as commercial procument type, such as China Airlines and Capital airport of China, and their software testing practice was mainly focused on acceptance testing and resigned to the third-party testing. Although there were some testing work existed in local second development, the work was finished by the developers but the professional testers.

Secondly, some moderate scale airports or airline companies which core system were joint-developed with professional company, such as Xiamen Airline, could be characterized as joint-development type. For this type of units, the software testing was not paid enough attention, even there was no professional testers during development process.

Thirdly, the professional software development corporation which had career man of software testing and independent department of software testing, such as China Travel Sky Holding Company, could be characterized as self-development type. In this type of unit, a special department for software testing was built up but the quantity of career man on testing was low and could not meet the average level in China, even less the level of developed countries.

On the basis of above mentioned classification on software testing of civil aviation, it could be concluded into the following characteristics according to the investigations on some organizations and companies in civil aviation field. On the one hand, the absensence of professional software testing or paying no much attention on the software testing in development process leaded to no guaranty of software quality. On another hand, short handedness of software testers, especially senior or skillfully testers, leaded to insufficient understanding on testing method and finally could not cover the system function. Additionally, the environment of software testing was also in complete for the effective testing, such as testing tools and system.

3 Advices on software testing system of civil aviation

3.1 Personnel management and system

Firstly, the proportion of software tester in development team should be increase. When Microsoft Company developed the Windows 2000 system, 250 project managers and 1700 developers were employed, and the numbers of software testers were up to 3200 and almost twice of the developers. In HP Company, the proportion of testers and developers was one to one and this was common in most of advanced software development companies. Consequently, increasing the proportion of testers and strengthening the quality of testers in the development was very necessary for improving the software quality and accelerating the build-up of information of civil aviation.

Secondly, the quality of testers must be improved and should have some basic requirements, such as exploration spirit, creativity and communication ability etc. There were mainly three type of person needed to be educated, i.e. operators of testing, developers of testing technology and manager of testing. For test manager, they should understand the intension and conception of software testing and know the software quality was the first aim. For developers of testing technology, they should keep refreshing with the newest and developing testing technology and must pass the professional quality authentication test. For the operators of testing, they should be familiar with the business of civil aviation and could combine the testing process with the special requirement in civil aviation.

3.2 Testing environment

Testing environment configuration was one of key phases in testing process and it would be effective on the testing result.

Testing environment include hardware and software environment configuration as showed in Fig.2. Hardware environment was constructed of devices which were necessary for testing, such as server, client terminal, internet link device, printer, scanner and other accessory devices. Software environment included the systems which were running in testing process, such as operation systems, databases, testing tools and other applied software.

Particularly, software configuration management and testing tool were much more important for testing process. Software configuration management was the specification of managing the software development and used to regulate the programming of developer for eliminating the error in development. Automated testing tools were often used to improve the testing efficiency and management level of whole testing process. To obtain the high efficiency of testing, expert tester assistance between tester and testing tool should be strengthened.

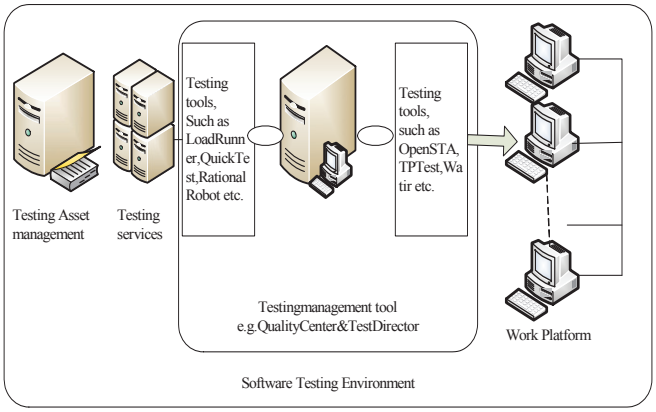


Figure 2. A schematic of testing environment system

For the most of circumstance, the testing should be finished under the real environment or actual operating mode for obtaining the efficient testing result. But because of the huge investment of testing environment, sometimes companies or organizations could finish the testing though the third-party or testing outsourcing.

In civil aviation field, the testing of third-party or testing outsourcing was a selectable way of lowering the software development cost and improving the software quality. In present, most of testing was consigned at the phase of acceptation. In fact , there were also some other testing services in third -party, such as software product registration testing, 、identification test, validation test, election test, acceptance test, Operation and maintenance test and information security test.

3.3 Quality Assurance System

To improve the quality of software, it is also very important to build up the full –scale software quality assurance system. The schematic of guaranty system for testing system is shown in Fig.3.

Despite of the marked development in software industry of China due to the advancement of global informatization, there was still a considerable gap in technology comparing with the developed countries. According to common opinions, although the backward was related with the poor foundation and late start of software industry, but there was still some other reasons lied with the unsound system in software industry, such as the mode of operation of the market, management philosophy and quality monitoring system. Presently, kinds of quality assurance system, Performance Management System (PMS) and Software Process Improvement (SPI) were developed to improve the software testing.

Because the software quality was the final aim of developing technology and verifying method in software development process, it was concerned through the whole Systems Development Life Cycle. It was necessary to build up a set of standards or specifications to make sure the quality of software. For example, ISO 9126 2001（GB/T 16260 2003）is such kind of software product quality standard to make demand on quality models, **e**xternal metrics, **i**nternal metrics and Software Quality Metrics,etc.

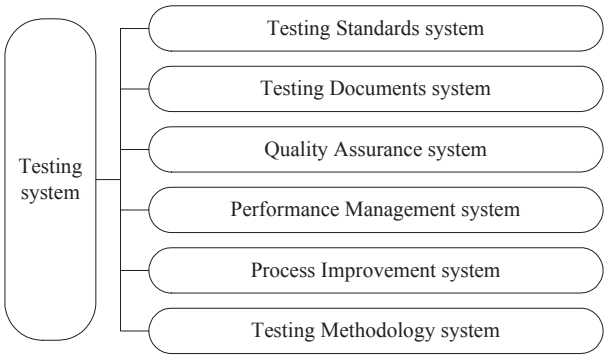


Figure 3. A schematic of guaranty system for testing system

Performance management systems was also two of key parts in quality system and used to built, collect, process and monitor the performance data. It was an important tool for achieving the aim of software testing.

Software process improvement was effective to the software testing for lowering the development cost and improving the efficiency and quality of testing process [4].

Software testing standard system was useful for improving the testing efficiency and was main way of guarantying the quality of software. A perfect software testing standard system could verify the quality requirement of software product to pass the quality regulation from development contract, development

plan and software design direction etc.

Software testing methodology system was used to find out according to the theory of bug finding. Therefore, it was necessary to build up the system of methodology for improving the efficiency and resolution way of bug in software.

4 Conclusions

For organizations and companies, there was still much work to do on research and study of software testing in civil aviation. The units could apply reasonable way and strategy to strengthen the testing and supervision on software quality according with themselves' services management structures. Especially, by accelerating the build-up of tester management system, testing environment and quality assurance system, the entire software testing system could be used to ensure the quality of application software and form the validated monitoring mechanism in civil aviation field.

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